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Abstract

BOILING FROM A LIQUID INTERFACE

by

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The paper presents the results of an investigation of boiling heat transfer from an ideally smooth surface, liquid to liquid interface. In this way, surface roughness is eliminated.

An original apparatus is described which eliminates by-effects (e.g. boiling from solid surface). Horizontal mercury surface was used as the heating surface from which four liquids were boiled at atmospheric pressure. The liquid surface (interface) was kept very clean by a special experimental procedure. The boiling liquids were water, ethyl alcohol, benzol and n-pentane, all with boiling points from 35 to 100°C.

The results of measurement of the boiling heat flux q, superheating of the heating liquid surface ΔT and the corresponding heat transfer coefficient α are presented. The superheating of the heating (liquid) surface was found to be higher than that of boiling from solid surfaces.

Two boiling regions, visually similar, are clearly distinguished, convective boiling and nucleate boiling; conditions of transfer from one kind of boiling to the other are shown. The heat transfer coefficient as a function of the driving temperature difference (surface superheating) for both regions can be represented by

$$\alpha = C(\Delta T)^n$$

where C is a constant dependent on physical parameters of boiling liquids and n a constant for all boiling liquids in the nucleate boiling region.

The heat transfer results for all liquids are correlated to the physical properties of boiling liquids and represented in the dimensionless form

$$Nu = f(Pr, Pe, Kp)$$

where variables Nu, Pr, Pe, and Kp are dimensionless numbers based on bubble parameters.

A preliminary study of nucleation mechanism by fast cine camera (6000 frames/sec) is reported. It was found that the bubble frequency increases with the increasing departing bubble diameter, which is opposite to the experimental results for boiling from solid surface. The possibilities of further detailed fast cine studies are discussed.

In conclusion, possibilities of practical application of this phenomenon for high efficiency-high flux heat transfer and heat generating apparatuses, including power reactors, are discussed.